Patent
Docket No.: 030262

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:	ASHOK MANTRAVARDI		
Application No.:	10/773,646	Confirmation No.:	7644
Filed:	February 5, 2004	Group Art Unit:	2618
Title:	CHANNEL ESTIMATION FOR A WIRELESS COMMUNICATION SYSTEM WITH MULTIPLE PARALLEL DATA STREAMS		

AMENDED BRIEF ON APPEAL

Mail Stop: Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This is an appeal from the final Office Action mailed on April 10, 2008, finally rejecting claims 1-36.

A Notice of Appeal in this application was filed on August 10, 2008, and was received in the USPTO on the same day.

REAL PARTY IN INTEREST

The real party in interest is Qualcomm Incorporated of San Diego, California.

RELATED APPEALS AND INTERFERENCES

Appellant is unaware of any related appeals or interferences.

STATUS OF CLAIMS

Claims 1-36 are pending. Claims 1-36 stand rejected, although specific art rejections of claims 35 and 36 on the merits were not specifically presented by the USPTO in the final Office Action, but merely alluded to in an Advisory Action dated July 8, 2008. The rejections of claims 1-36 are appealed.

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STATUS OF AMENDMENTS

An amendment was filed after the final rejection on June 6, 2008 amending claims 35 and 36. These amendments were subsequently entered as indicated in the Advisory Action dated July 8, 2008.

SUMMARY OF CLAIMED SUBJECT MATTER

The subject matter of the independent claims concern methods and apparatus for channel estimation for a wireless communication system that simultaneously transmits multiple data streams (Pg. 1, lines 1-3 of paragraph [0001]). In particular, the methods and apparatus are used, for example, in hierarchical coded systems that transmit broadcast data divided into two data streams; a base stream and an enhancement stream (Pg. 1, lines 4-5 of paragraph [0003], Pg. 2, lines 1-5 of paragraph [0005], and Pg. 4, lines 1-5 of paragraph [0019]). With hierarchical transmission, the base stream is transmitted such that all users in a broadcast area can recover this stream, whereas the enhancement stream is transmitted such that users experiencing better channel conditions can recover this stream (Pg. 1, lines 5-7 of paragraph [0003]). An estimation of the wireless channel over which the two data streams are transmitted is used to recover the base and enhancement streams (Pg. 2, lines 8-13 of paragraph [0004], which is the first paragraph on Pg. 2 and starts on Pg. 1).

An exemplary method illustrative of the subject matter of the claimed method in claim 1 is shown in Figure 1. The process 100 is for recovering at a receiver first and second data streams transmitted simultaneously via a wireless channel (Pg. 5, lines 1-2 of paragraph [0023] and Figure 1). The process 100 includes deriving a first channel estimate $\hat{H}_b$ for data subbands of the wireless channel based on received symbols (Pg. 5, lines 2-4 of paragraph [0023] and block 112 in Figure1).

The receiver then derives a data-directed second channel estimate $\hat{H}_{rb}$ for data subbands based on received data symbols and the remodulated sysmbols (i.e., derivation based on the detected first data stream) as illustrated in block 120 of Fig. 1 (Pg. 6, lines 1-3 of paragraph [0026]). After the second channel estimate is derived, the receiver then derives third channel estimate, which is an enhanced channel estimate $\hat{H}_e$, by combining the initial or first channel estimate $\hat{H}_b$ with the data-directed or second channel estimate $\hat{H}_{rb}$ (Pg. 7, lines 1-2 of paragraph [0028] and block 122 in Figure 1).

Finally, the second data stream (e.g., the enhanced data stream of the first data stream $\{\hat{s}_e\}$) is detected with the estimated interference from the base stream canceled (Pg. 8, lines 4-5 of paragraph [0030] and block 132 of Figure 1) and using the third channel estimate (i.e., the enhanced channel estimate $\hat{H}_e$) (Pg. 7, lines 1-2 of paragraph [0031] and block 134 of Figure 1).

Similar to claim 1 discussed above, the exemplary method of independent claim 33 is also illustrated by Figure 1. The process 100 is for recovering at a receiver first and second data streams transmitted simultaneously via a wireless channel (Pg. 5, lines 1-2 of paragraph [0023] and Figure 1). The process 100 includes deriving a first channel estimate $\hat{H}_b$ for data subbands of a wireless channel based on received symbols, such as pilots symbols received along with combined symbols (Pg. 5, lines 2-4 of paragraph [0023] and block 112 in Figure1). The receiver performs detection for the first data stream (i.e., the base stream) using the first channel estimate $\hat{H}_b$ (Pg. 5, lines 1-2 and block 114 in Figure 1). The detected symbols $\{\hat{s}_b\}$ are decoded to obtain a decoded base stream $\{\hat{d}_b\}$, which is an estimate of the transmitted base stream $\{d_b\}$ (Pg. 6, lines 1-3 of paragraph [0025] and block 116 in Figure 1). The receiver further 're-encodes" the decoded base stream $\{\hat{d}_b\}$ to obtain remodulated symbols $\{\tilde{s}_b\}$, which are estimates

of the transmitted data symbols for the base stream $\{s_b\}$ (Pg. 6, lines 9-11 of paragraph [0025] and block 116 in Figure 1).

The receiver then derives a data-directed second channel estimate $\hat{H}_{rb}$ for data subbands based on received data symbols and the remodulated sysmbols (i.e., derivation based on the detected first data stream) as illustrated in block 120 of Fig. 1 (Pg. 6, lines 1-3 of paragraph [0026]). After the second channel estimate is derived, the receiver then derives third channel estimate, which is an enhanced channel estimate $\hat{H}_e$, by combining the initial or first channel estimate $\hat{H}_b$ with the data-directed or second channel estimate $\hat{H}_{rb}$ (Pg. 7, lines 1-2 of paragraph [0028] and block 122 in Figure 1). Next, interference due to the base stream is estimated using the third channel estimate $\hat{H}_e$ (Pg. 8, lines 1-2 of paragraph [0030] and block 132 in Figure 1).

Next, the second data stream (e.g., the enhanced data stream of the first data stream $\{\hat{s}_e\}$) is detected with the estimated interference from the base stream canceled (Pg. 8, lines 4-5 of paragraph [0030] and block 132 of Figure 1) and using the third channel estimate (i.e., the enhanced channel estimate $\hat{H}_e$) (Pg. 7, lines 1-2 of paragraph [0031] and block 134 of Figure 1). Finally, the receiver decodes the detected symbols for the enhancement stream $\{\hat{s}_e\}$ to obtain decoded data for the enhancement stream $\{\hat{d}_e\}$ (Pg. 9, lines 9-10 of paragraph [0031] bridging pages 8 and 9, which are also lines 4-5 from the top of page 9, and block 136 in Figure 1).

A block diagram illustrative of the subject matter of a claimed apparatus (claim 27), which is operable to recover first and second data streams transmitted simultaneously via a wireless channel in a wireless communication system, is illustrated by Figure 6. The apparatus of Figure 6, which is a receiver, includes a channel estimator 470 having a pilot channel estimator 670a that is configured to derive a first channel estimate $\hat{H}_b$ for the wireless channel based on received symbols; namely pilot symbols $\{y_p\}$ (Pg. 20, lines 1-2 of paragraph [0066]). Channel estimator 470 also includes an enhanced channel estimator 670b configured to derive a second channel estimate $\hat{H}_{rb}$ based on detected symbols for the first data stream (i.e., based on $\{y_p\}$ and remodulated symbols $\{\tilde{s}_b\}$ from a TX data stream processor 692) (Pg. 20, lines 1- 7 of paragraph [0067]). The enhanced channel estimator also derives a third channel estimate, which

is an enhanced channel estimate $\hat{H}_e$), based on a combination of the first and second channel estimates $\hat{H}_b$ and $\hat{H}_{rb}$ (Pgs. 20-21, lines 7-9 of paragraph [0067], which bridges pages 20 and 21).

The receiver apparatus in Figure 6 also includes a detector 480 having a base stream detector 680a, which is configured to perform detection for the first data stream using the first channel estimate to provide the detected symbols for the first data stream (i.e., detecting the base data stream $\{y_d\}$ using channel estimate $\hat{H}_b$ to provide detected symbols $\{\hat{s}_b\}$ for the base stream) (Pg. 20, lines 5-7 of paragraph [0066]). Detector 480 also includes an enhancement stream detector 680b that is configured to perform detection for the second data stream (i.e., the enhancement stream) using the third, enhanced channel estimate $\hat{H}_e$, and to provide detected symbols $\{\hat{s}_e\}$ for the second, enhancement data stream (Pg. 21, lines 13-17 of paragraph [0067], which bridges pages 20-21 (or lines 5-9 from the top of page 21)).

Subject matter of another independent claim (claim 30) includes an apparatus configured to recover first and second data streams-transmitted simultaneously via a wireless channel in a wireless communication system. The apparatus includes means for deriving a first channel estimate for the wireless channel based on received symbols, whose function (Pg. 5, lines 2-4 of paragraph [0023] and block 112 in Figure1) may be performed with structures such as channel estimator 470 illustrated in Figure 4 or pilot channel estimator 670a in channel estimator 470 illustrated in Figure 6, or equivalents. The apparatus also includes means for performing detection for the first data stream using the first channel estimate, where this function (Pg. 5, lines 1-2 and block 114 in Figure 1) may be implemented by the detector 480 in Figure 4 or base stream detector 680a in detector 480 of Figure 6, or equivalents.

Further, the claimed subject matter includes means for deriving a second channel estimate based on the detected first data stream channel. The structure to accomplish this functionality (Pg. 6, lines 1-3 of paragraph [0026] and block 120) may include estimator 470 in Figure 4 or enhanced channel estimator 670b within detector 470 in Figure 6 , or equivalents. Additionally, the claimed subject matter includes means for deriving a third channel estimate based on the first and second channel estimates (470). This function (Pg. 7, lines 1-2 of paragraph [0028] and block 122 in Figure 1) may be accomplished by structures including channel estimator 470 in Figure 4 or enhanced channel estimator 670b of channel estimator 470

(See e.g., Pg. 20, lines 1- 7 of paragraph [0067]), or equivalents. Finally, the apparatus includes means for performing detection for the second data stream using the third channel estimate, where the second data stream in an enhancement stream of the first data stream. This function may (See e.g., Pg. 7, lines 1-2 of paragraph [0031] and block 134 of Figure 1) be effected by the structures of detector 480 in Figure 4 or enhancement stream detector.680b and interference canceller 682 of detector 480 in Figure 6, or equivalents.

Concerning the claimed subject matter of independent claim 35, this claim contains subject matter of a computer related medium containing code (or a software implementation) of the functions claimed in claim 1, for example, which was already discussed above (See also, pg. 24, lines 1-7 of paragraph [0078]. Finally concerning the claimed subject matter of independent claim 36, this claim contains subject matter of a processor apparatus, such as controller 452 in Figure 4 as an example, that is operable to perform or effect the functions claimed in claim 1, for example, which was already discussed above (See also, Pg. 24, paragraphs [0077] and [0078] in their entirety).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

First Ground of Rejection

Whether claims 1-5, 7, 8, 12-14, 17-22, and 27-34 are unpatentable under 35 USC § 103(a) over the combined teachings of Kowalewki (U.S. Patent No. 7,55,16) in view of Walker et al. (U.S. Patent No. 7,215,713).

Second Ground of Rejection

Whether claims 6 and 9-11 are unpatentable under 35 USC § 103(a) over the combined teachings of Kowalewki (U.S. Patent No. 7,55,16) and Walker et al. (U.S. Patent No. 7,215,713) in view of Cioffi et al. (U.S. Patent No. 5,995,567).

Third Ground of Rejection

Whether claims 15, 16 and 23-26 are unpatentable under 35 USC § 103(a) over the combined teachings of Kowalewki (U.S. Patent No. 7,55,16), Walker et al. (U.S. Patent No. 7,215,713), and Cioffi et al. (U.S. Patent No. 5,995,567) in view of Isaksson et al. (U.S. Patent No. 6,181,714).

ARGUMENT

First Ground of Rejection

Claims 1-5, 7, 8, 12-14, 17-22, and 27-34 stand rejected under 35 USC § 103(a) as purportedly being unpatentable over the combined teachings of Kowalewki (U.S. Patent No. 7,55,16) in view of Walker et al. (U.S. Patent No. 7,215,713). Appellant respectfully requests that this rejection be reversed.

Claims 1, 2, 5, 7, 8, 12, 14, 20-22, 27, 30 and 34

In the rejection of claim 1, the Examiner has asserted that Kowalewki teaches all of the claimed elements of this method, save a second data stream being an enhancement of a first data stream. Walker et al. is asserted as teaching or suggested the missing elements. Appellant respectfully submits, however, that these assertions are in error, and that the combination of Kowalewki and Walker et al., in fact, does not teach the claimed elements they are purported as teaching. It remains well-settled law that in order to establish *prima facie* obviousness of a claimed invention, all the claim features must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). When determining whether a claim is obvious, an examiner must make "a searching comparison of the claimed invention – including all its limitations – with the teaching of the prior art." *In re Ochiai*, 71 F.3d 1565, 1572 (Fed. Cir. 1995) (emphasis added). As the present rejection has not established that all of the claimed elements are actually taught or suggested, *prima facie* obviousness has not been established.

As a first example of the lack of *prima facie* obviousness, claim 1 features "deriving a second channel estimate based on [a] detected first data stream." As discussed in the background above, this claimed feature is derivation of an exemplary second channel estimate $\hat{H}_{rb}$ based on the detected first data stream (e.g., the base stream), which was detected using a first channel estimate $\hat{H}_b$. The rejection of this claim element in the final Office Action of April 10, 2008, asserts that teaching of this element is found in col. 7, lines 38-41 of Kowalewki (See item No. 3 on page 3). Neither this referenced section nor the rest of Kowalewki actually teaches this claimed element. Instead, the cited section, for example, unequivocally teaches that separate and distinct channel estimates of first and second channels (20 and 25), not streams, are derived by

respective estimators 11 and 12. Thus, each channel estimate in Kowalewki is based on a respective channel and to assert that this is equivalent to "deriving a second channel estimate based on a detected first data stream" is simply incorrect. Kowalewki derives first and second channel estimates from respective first and second channels (20 and 25) independently, and each respective channel estimate is not based on the other. This is further borne out by the diagram of Figure 3, which is referred to in the cited section of Kowalewki, showing first transceiver 30 receiving channel 20 using channel estimator 11 and second transceiver 35 receiving second channel 25 using a second channel estimator 12.

In response to the arguments above, the Examiner asserts in the Advisory action of July 8, 2008 (See item No. 1 on page 2), that "the claims do not state specifically how the second channel estimate is based on the first detected data stream and so on." The claim phrase in question here in claim 1, however, states "deriving a second channel estimate based on the detected first data stream." Thus, it is not a question of how the second channel is based, but rather that it is *derived* based on a detected first data stream.

The Examiner continues by stating that "if the first data stream affects the second channel estimate in any way, then the second channel estimate can be derived based on a first data stream." This is an incorrect statement because the term "derived" is being interpreted beyond what is reasonable as being subsumed by the meaning of the word "affects." As discussed in Section 2111.01 of the M.P.E.P., during examination claims are interpreted as broadly as their terms reasonably allow. *In re American Academy of Science Tech Center*, 367 F.3d 1359, 1369, 70 USPQ2d 1827, 1834 (Fed. Cir. 2004). This means that the words of the claim must be given their plain meaning unless the plain meaning is inconsistent with the specification. *In re Zletz*, 893 F.2d 319, 321, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989). The word "derived" in the claim means "to arrive at by reasoning; deduce or infer." *The American Heritage® Dictionary of the English Language*, Fourth Edition. Houghton Mifflin Company, 2004. In other words, the second channel estimate is deduced, in this case mathematically as discussed in paragraph [0026], for example, from the detected first data stream. In contrast, the word "affect," as defined in the same dictionary, means "to have an influence on or effect a change in." The second channel estimate is, in this sense, not merely "affected" by the first data stream (i.e., influenced or changed by), but is instead derived from. The Examiner is not free to disregard or change the meaning of "derived" and this is not a reasonable interpretation.

It is also noted in passing, that this conclusory statement is further illogical. It is a *non sequitur* to state that because a first thing affects a second thing, then it follows that the second thing can be derived from the first. The illogic here is making the false assumption that derivation of the second channel estimate is commutative with detection of the first data stream. This is akin to saying that if noise affects a signal, then the signal can be derived based on the noise. This is not coherent logic on which to properly establish a rejection. The Federal Circuit has stated that "rejections on obviousness cannot be sustained with mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006). See also *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___, ___, 82 USPQ2d 1385, 1396 (2007) (quoting Federal Circuit statement with approval). This standard has not been met here.

Nonetheless, based on this faulty interpretation and reasoning, the Examiner asserts that since Figure 2 of Kowalewki shows first and second channel estimates come from the same transceiver and the same antenna, "it can be assumed the first data stream affects the second data stream in some shape or form," and thus the references teaches deriving a second channel estimate based on a first detected data stream. This misconstrues what Kowalewki actually teaches in connection with Figure 2. The transceiver 30 in Figure 2 sends received signals 20 and 25, which are two separate channels and not hierarchical coding (i.e., two data streams), to a channel estimator 11 for estimation of a total impulse response (col. 6, ll. 3-6). Only one total impulse response is estimated by Kowalewki in the embodiment of Figure 2, and although the different channels 20, 25 might affect one another in derivation of the total impulse response output by estimator 11, it is not the same as a second channel estimation based on a first detected data stream, which was detected based on a first channel estimate as featured in claim 1.

As another example of the lack of *prima facie* obviousness, the final Office action asserts that col. 6, lines 27-38 in Kowalewki teach the featured claim 1 element of "deriving a third channel estimate based on the first and second channel estimates." This assertion is incorrect as Kowalewki in either the cited section or the rest of the reference does not teach or suggest this element. Taking the example of the cited section, this section actually teaches addition of two received signals (not channel estimates) by an addition member 80 (See e.g., col. 6, line 27). This is simply adding signals for input to a demodulator 7, and in no way is a teaching or

suggestion of deriving a channel estimate. Moreover, although Kowalewki may teach deriving a channel estimate at channel estimator 11 from superimposed signals (col. 6, ll. 54-56), the reference does not teach anywhere a derivation of a channel estimate based on another channel estimate, let alone two other channel estimates as featured in claim 1.

The Advisory action, in response to above arguments, merely contends that the cited section clearly teaches the claimed subject matter without any further support but to once again reference the same section of Kowalewki (See pg. 2 of the Advisory action). As argued above, this section does not teach the claimed subject matter.

Appellant further notes that one skilled in the art would not receive motivation from the teachings of Kowalewki, Walker et al., or knowledge in the art to combine the cited teachings of Walker et al. with Kowalewki. In particular, Kowalewki does not relate to hierarchical transmission; namely the transmission of a second data stream that is an enhancement stream of a first data stream. Rather, Kowalewki relates to transmitting pre-equalized signals over a plurality of radio channels rather than the prior art method of a multi-path occurrence of the transmission of a single channel, to mitigate fading incursions inherent in the prior art (See e.g., col. 1, ll. 17-33). Thus, it would be incorrect to characterize these multiple radio channels of Kowalewki as being a first data stream and a second data stream that is an enhancement of the first, since this would have no bearing or relevance on mitigating fading due to multi-path occurrences. Accordingly, no advantage is provided by the teachings of Walker et al. (i.e., hierarchical transmission) that effect a further benefit to the purpose of Kowalewki, which is to minimize fading incursions. Stated another way, adding hierarchical transmission to one or more of the channels in Kowalewki, while ostensibly increasing data rates, would not provide a beneficial effect on reducing fading, thus rendering the reasoning for combining irrational when considering the references as a whole. Thus, this rejection fails to meet criteria proffered by the U.S. Supreme Court requiring "rejections on obviousness ... [to possess] some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *Id.*

In light of the foregoing comments, it is respectfully submitted that independent claim 1 patentably distinguishes over the cited references, either separate or in combination.

Claims 2, 5, 7, 8, 12, 14, and 20-22, which ultimately depend from claim 1, are also patentably distinguished over the cited references due to their dependency on claim 1.

Concerning independent claims 27 and 30, these apparatus claims contain elements complimentary to those discussed above in connection with claim 1. Accordingly, these claims are believed patentable for at least the same reasons.

It is also noted here that although claims 35 and 36 were indicated in the Advisory action as rejected (See pg. 3 of the Advisory action dated July 8, 2008), they were not previously examined on their merits. Notwithstanding, these claims recite features substantially similar to those described above with reference to independent claim 1. Thus, claims 35 and 36 are submitted to be patentable for at least the same reasons provided above for independent claim 1.

Claims 33 and 34

Concerning independent claim 33, this claim contains similar elements to claim 1, discussed above. Thus, rather than repeat the arguments Appellant refers to the arguments above for similar elements of claims 1 and 33. Nonetheless, claim 33 also features additional elements that are not taught or suggested by the cited references, either combined or separately.

Claim 33 features, among other things, "re-encoding the decoded data from the base stream to obtain remodulated symbols for the base stream." The final Office Action (See pg. 8) asserts that Kowalewki discloses this feature and cites col. 6, lines 14-27 in support of this assertion. Neither cited section or any other portion of Kowalewki, however, teaches any remodulation of any channel, let alone symbols of a base stream. Accordingly, a prima facie case of obviousness is further not established as this element is neither taught nor suggested by Kowalewki.

In another example, claim 33 also features "estimating interference due to the base stream using the third channel estimate." The final Office Action refers to col. 6, lines 54-56 as teaching this element. This section, however, does not teach interference estimation, but rather discusses superimposition of two channels when determining a channel estimation. Further, Kowalewki does not teach or suggest estimation of interference due to a base stream (nor would it as hierarchical coding is not taught as recognized by the Examiner) and a third channel estimate, as argued previously with respect to claim 1. Walker et al. is also devoid of such teaching or suggestion. Accordingly, for these further reasons, claim 33 is patentably distinct over the cited references.

Claim 34, which depends from claim 33, is also patentably distinguished over the cited references due to its dependency on claim 33.

Claims 3, 28, and 31

The final Office Action also asserts that the elements of dependent claims 3 and 31 are taught by Kowalewki in col. 6, lines 27-38 and claim 28 in col. 4, lines 41-47. In particular, the subject matter of these claims relates to estimating interference due to the first data stream using the third channel estimate, and detection for the second data stream performed with the estimated interference from the first data stream canceled. As discussed before, Kowalewki does not teach or suggest a third channel estimate, thus for at least this reason, the elements of these claims are not taught or suggested. Furthermore, the cited sections of Kowalewki do not actually teach an estimation of interference of a first data stream (e.g., a base stream) using a third channel estimate that is used to detect a second data stream (e.g., an enhancement stream) with the estimated interference from the first data stream canceled. Merely because interference is recognized and accounted for in a modulator (See e.g., col. 4, lines 52-60 in Kowalewki) does not equal a teaching of the specific claimed elements, nor relieve the Examiner from pointing out how claim elements are specifically met by the reference.

Claim 4

The final Office action alleges that Kowalewki further teaches first and second data streams combined prior to transmission via the wireless channel, as featured in claim 4. In support of this assertion, the addition member 80 in Figure 2 is referenced without any further explanation. An assertion based on addition member 80 is incorrect, however, as this member is actually used on a receiver end before demodulation by a first demodulator 7. Thus, this member 80 is necessary because transmission was performed with two separate channels that are added together after transmission, not combined streams combined before transmission. Accordingly, this teaching is the opposite of claim 4. Furthermore, Kowalewki does not teach hierarchical coding, so it contains no teaching or even suggestion of combing data streams into a single wireless channel.

Claims 13, 29 and 32

Claims 13, 29, and 32, among other things, feature common elements concerning re-encoding decoded data to obtain remodulated symbols for the first data stream. The final Office Action alleged these claimed elements are taught by Kowalewki in col. 6, lines 14-27. This section of Kowalewki, as well as the remainder of the reference, actually do not teach or suggested re-encoding decoded data to obtain remodulated symbols. This concept is simply absent from the cited reference.

Claims 17-19

Claims 17-19, among other things, include derivation of a third channel estimate or use of third channel estimate. As discussed before, the prior art of record does not teach or suggest derivation of a third channel estimate in the context of the claimed subject matter as a whole. Thus, these claims further patentably distinguish over the cited references.

In light of the foregoing, Appellant asserts that the first ground of rejection should now be reversed.

Second Ground of Rejection

Claims 6 and 9-11 are rejected as purportedly unpatentable under 35 USC § 103(a) over the combined teachings of Kowalewki (U.S. Patent No. 7,55,16) and Walker et al. (U.S. Patent No. 7,215,713) in view of Cioffi et al. (U.S. Patent No. 5,995,567). Appellant respectfully requests that this rejection be reversed for the following reasons.

Claim 6 depends on claim 5, which depends from independent claim 1. Without repeating the arguments made concerning the first ground of rejection above, Appellant submits that claim 6 is at least patentable over Kowalewki and Walker et al. due to its dependency from claim 1. Cioffi et al., which was relied upon merely for teaching concepts of fast Fourier Transform (FFT) and inverse fast Fourier Transform (IFFT), does not teach or suggest the elements missing from Kowalewki and Walker et al. Accordingly, claim 6 is submitted as patentably distinguishable over the cited prior art.

Dependent claims 9-11, which ultimately depend from independent claim 1, are therefore also patentable at least due to their dependency on independent claim 1. Furthermore, Appellant submits that the elements of these claims are not taught by Cioffi et al.. In particular, Cioffi et al.

does not teach or suggest derivation of first, second, and third channel estimates, but merely relates RF noise cancellation prior to digital signal processing (See e.g., abstract and Fig. 1). Thus, the assertions in the final Office Action that Cioffi teaches first, second, and third channel estimates is false. Furthermore, since Cioffi et al. relates to RF noise cancellation before digital signal processing (albeit in conjunction with feedback from a digital signal processor), the specific elements of claims 9-11 concerning channel estimates using channel gain estimates for first and second groups of subbands, and frequency interpolation would not be taught or even suggested by Cioffi et al.

In light of the foregoing, Appellant asserts that the second ground of rejection should now be reversed.

Third Ground of Rejection

Claims 15, 16, and 23-26 were rejected under 35 USC § 103(a), as purportedly being unpatentable over Kowalewki, Walker et al., Cioffi et al., and further in view of Isaksson et al. (U.S. Patent No. 6,181,714).). Appellant respectfully requests that this rejection be reversed for the following reasons.

In particular, these claims depend directly or indirectly from independent claim 1, which was argued above to be patentable over Kowalewki and Walker et al. Thus, without repeating the above arguments, these claims are allowable at least due to their dependencies. It is noted that Isaksson et al., which was relied upon as teaching the concepts of scaling, OFDM, and MIMO systems, does not teach or suggest the elements missing from Kowalewki, Walker, and Cioffi. In passing, it is also noted that is unclear why Cioffi et al. was used in this ground of rejection, as claims 15, 16, and 23-26 do not depend directly from any of claims 6 or 9-11, and do not share similar claim elements.

In light of the foregoing, Appellant asserts that the third ground of rejection should now be reversed.

CONCLUSION

For the foregoing reasons, Appellant respectfully submits that the Examiner has erred in rejecting this application. Please reverse the Office Action on all grounds.

Respectfully submitted,

November 29, 2008
Date

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STATUS OF CLAIMS INVOLVED WITH THE APPEAL

APPENDIX

1. A method of recovering first and second data streams transmitted simultaneously via a wireless channel in a wireless communication system, comprising:

deriving a first channel estimate for the wireless channel based on received symbols;

performing detection for the first data stream using the first channel estimate;

deriving a second channel estimate based on the detected first data stream;

deriving a third channel estimate based on the first and second channel estimates; and

performing detection for the second data stream using the third channel estimate, wherein the second data stream is an enhancement stream of the first data stream.

2. The method of claim 1, wherein the first channel estimate for the wireless channel is derived based on received pilot symbols.

3. The method of claim 1, further comprising:

estimating interference due to the first data stream using the third channel estimate, and wherein the detection for the second data stream is performed with the estimated interference from the first data stream canceled.

4. The method of claim 3, wherein the first and second data streams are combined prior to transmission via the wireless channel.

5. The method of claim 1, wherein the deriving a first channel estimate includes

obtaining a frequency response estimate for the wireless channel based on the received pilot symbols,

deriving a time-domain impulse response estimate for the wireless channel based on the frequency response estimate, and

deriving the first channel estimate based on the time-domain impulse response estimate.

6. The method of claim 5, wherein the time-domain impulse response estimate is derived by performing an inverse fast Fourier transform (IFFY) on the frequency response estimate, and wherein the first channel estimate is derived by performing a fast Fourier transform (FFT) on the time-domain impulse response estimate.

7. The method of claim 1, wherein the deriving a second channel estimate includes

obtaining a frequency response estimate for the wireless channel based on the detected first data stream,

deriving a time-domain impulse response estimate for the wireless channel based on the frequency response estimate, and

deriving the second channel estimate based on the time-domain impulse response estimate.

8. The method of claim 1, wherein the first and second channel estimates are time-domain impulse response estimates, and wherein the third channel estimate is a frequency response estimate derived by combining and transforming the time-domain impulse response estimates for the first and second channel estimates.

9. The method of claim 1, wherein the first channel estimate comprises channel gain estimates for a first group of subbands and the second channel estimate comprises channel gain estimates for a second group of subbands, and wherein the third channel estimate is derived based on a concatenation of the channel gain estimates for the first and second groups of subbands.

10. The method of claim 9, wherein the third channel estimate is derived by frequency interpolation of the channel gain estimates for the first and second groups 'of subbands.

11. The method of claim 9, wherein the first group of subbands is used for pilot transmission and the second group of subbands is used for data transmission.

12. The method of claim 1, wherein the detection for the first data stream is performed on received data symbols and provides detected symbols for the first data stream.

13. The method of claim 12, further comprising:

decoding the detected symbols for the first data stream to obtain decoded data for the first data stream; and

re-encoding the decoded data to obtain remodulated symbols for the first data stream, and wherein the second channel estimate is derived based on the remodulated symbols and the received data symbols.

14. The method of claim 12, further comprising:

mapping the detected symbols for the first data stream to modulation symbols based on a modulation scheme used for the first data stream, and wherein the second channel estimate is derived based on the modulation symbols and the received data symbols.

15. The method of claim 1, wherein the deriving a third channel estimate includes

scaling the first channel estimate with a first scaling factor,

scaling the second channel estimate with a second scaling factor, and

combining the scaled first channel estimate and the scaled second channel estimate to obtain the third channel estimate.

16. The method of claim 15, wherein the first and second scaling factors are selected based on reliability of the first channel estimate relative to reliability of the second channel estimate.

17. The method of claim 1, further comprising:

filtering the first channel estimate, and wherein the third channel estimate is derived based on the filtered first channel estimate.

18. The method of claim 1, further comprising:

filtering the second channel estimate, and wherein the third channel estimate is derived based on the filtered second channel estimate.

19. The method of claim 1, further comprising:

filtering the third channel estimate, and wherein the detection for the second data stream is performed using the filtered third channel estimate.

20. The method of claim 1, further comprising:

filtering the first, second, or third channel estimate in time domain or frequency domain.

21. The method of claim 20, wherein the filtering is performed with an infinite impulse response (IIR) filter.

22. The method of claim 20, wherein the filtering is performed with a finite impulse response (FIR) filter.

23. The method of claim 1, wherein the wireless communication system utilizes orthogonal frequency division multiplexing (OFDM).

24. The method of claim 23, wherein the received pilot symbols are obtained in each OFDM symbol period and for a set of subbands used for pilot transmission.

25. The method of claim 23, wherein the received pilot symbols are obtained for OFDM symbol periods used for pilot transmission, wherein the first channel estimate is derived for each OFDM symbol period used for pilot transmission, and wherein the second channel estimate is derived for each OFDM symbol period used for data transmission.

26. The method of claim 1, wherein the wireless communication system is a multiple-input multiple-output (MIMO) communication system, and wherein the first and second data streams are transmitted simultaneously from a plurality of antennas.

27. An apparatus operable to recover first and second data streams transmitted simultaneously via a wireless channel in a wireless communication system, comprising:

a channel estimator operative to derive a first channel estimate for the wireless channel based on received symbols, derive a second channel estimate based on detected symbols for the first data stream, and derive a third channel estimate based on the first and second channel estimates; and

a detector operative to perform detection for the first data stream using the first channel estimate, provide the detected symbols for the first data stream, perform detection for the second data stream using the third channel estimate, and provide detected symbols for the second data stream, wherein the second data stream is an enhancement stream of the first data stream.

28. The apparatus of claim 27, wherein the detector is further operative to estimate interference due to the first data stream using the third channel estimate and to perform detection for the second data stream with the estimated interference from the first data stream canceled.

29. The apparatus of claim 27, further comprising:

a receive data processor operative to decode the detected symbols for the first data stream to obtain decoded data for the first data stream and to re-encode the decoded data to obtain remodulated symbols for the first data stream, and wherein the channel estimator is operative to derive the second channel estimate based on the remodulated symbols and received data symbols.

30. An apparatus operable to recover first and second data streams-transmitted simultaneously via a wireless channel in a wireless communication system, comprising:

means for deriving a first channel estimate for the wireless channel based on received symbols;

means for performing detection for the first data stream using the first channel estimate;

means for deriving a second channel estimate based on the detected first data stream;

means for deriving a third channel estimate based on the first and second channel estimates; and

means for performing detection for the second data stream using the third channel estimate, wherein the second data stream in an enhancement stream of the first data stream.

31. The apparatus of claim 30, further comprising:

means for estimating interference due to the first data stream using the third channel estimate, and wherein the detection for the second data stream is performed with the estimated interference from the first data stream canceled.

32. The apparatus of claim 30, further comprising:

means for decoding detected symbols for the first data stream to obtain decoded data for the first data stream, and

means for re-encoding the decoded data to obtain remodulated symbols for the first data stream, and wherein the second channel estimate is derived based on the remodulated symbols and received data symbols.

33. A method of recovering a base stream and an enhancement stream of the base stream transmitted simultaneously via a wireless channel in a wireless communication system, comprising:

deriving a first channel estimate for the wireless channel based on received pilot symbols;

performing detection for the base stream using the first channel estimate to obtain detected symbols for the base stream;

decoding the detected symbols for the base stream to obtain decoded data for the base stream;

re-encoding the decoded data for the base stream to obtain remodulated symbols for the base stream;

deriving a second channel estimate based on the remodulated symbols;

deriving a third channel estimate based on the first and second channel estimates;

estimating interference due to the base stream using the third channel estimate;

performing detection for the enhancement stream, with the estimated interference from the base stream canceled and using the third channel estimate, to obtain detected symbols for the enhancement stream; and

decoding the detected symbols for the enhancement stream to obtain decoded data for the enhancement stream.

34. (Original) The method of claim 33, wherein the deriving a first channel estimate includes

obtaining a frequency response estimate for the wireless channel based on the received pilot symbols,

deriving an impulse response estimate for the wireless channel based on the frequency response estimate, and

deriving the first channel estimate based on the impulse response estimate.

35. A computer-readable medium storing instructions thereon for recovering first and second data streams transmitted simultaneously via a wireless channel in a wireless communication system, the computer-readable medium comprising:

code for causing a computer to derive a first channel estimate for the wireless channel based on received symbols;

code for causing a computer to perform detection for the first data stream using the first channel estimate;

code for causing a computer to derive a second channel estimate based on the detected first data stream;

code for causing a computer to derive a third channel estimate based on the first and second channel estimates; and

code for causing a computer to perform detection for the second data stream using the third channel estimate, wherein the second data stream is an enhancement stream of the first data stream.

36. A processor configured to execute instructions for recovering first and second data streams transmitted simultaneously via a wireless channel in a wireless communication system, wherein the processor executing the instructions is operable to:

derive a first channel estimate for the wireless channel based on received symbols;

perform detection for the first data stream using the first channel estimate; instructions to derive a second channel estimate based on the detected first data stream;

derive a third channel estimate based on the first and second channel estimates; and

perform. detection for the second data stream using the third channel estimate, wherein the second data stream is an enhancement stream of the first data stream.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.